

solve such calcium carbonate as it comes in contact with, especially dead shells and skeletons. Three reasons for this may be adduced :—

(1) There may be local accessions of  $\text{CO}_2$ , the dissolving power of which has already been referred to. The sarcode of molluscs and the albuminous binding material of their shells are decomposed, on the death of the animal, to  $\text{CO}_2$  and ammonia, the former being much in excess. The solvent thus provided, in the case of any given shell-forming organism, can only, however, be small relatively to the calcareous matter present.

(2) The carbonate may be in a less stable, and therefore more soluble, form than calcite. This is eminently true of corals, which are mainly aragonitic. Some shells also are wholly or partially aragonitic, and marine aragonitic algæ occur, such as *Halimeda*. Sea-water saturated for calcite would, needless to say, be unsaturated for aragonite.

(3) It is a familiar fact that freshly precipitated calcium carbonate is much more soluble than the stable macrocrystalline modification. The older theory, which supposed the former to be basic or hydrated  $\text{CaCO}_3$ , seems open to doubt, since there is no sort of evidence that such compounds exist. More probably the abnormal solubility is due to the exceedingly small size of the particles. Above a certain limit of size, the concentration of saturated solutions of a solid is constant, whether the particles be large or small; below this limit the concentration becomes greater the smaller the particles, these stronger solutions being in perfectly stable equilibrium with solid particles of a definite magnitude. Experimental observations of this phenomenon, which may be an effect of surface-tension between solid and liquid, have in recent times been made on a variety of substances.<sup>1</sup> The limiting size for abnormal solubility is about  $2\mu$  diameter for gypsum, and will hardly be very different for calcium carbonate. It may be that what is called amorphous calcium carbonate is often merely calcite or aragonite in a state of extremely fine subdivision, whence the higher solubility. Abnormal solutions thus produced are of course supersaturated for larger particles, but there is evidence that they part with their surplus solute with extreme reluctance.

In all probability, then, the particles of calcium carbonate of organic origin in the sea, which are protected, during life, by albuminoid matter, go into solution, in the course of their post-mortem descent, by virtue of their minute size, and leave trails

<sup>1</sup> See Hulett, *Zeitschr. Phys. Chem.*, vol. xxxvii. p. 385, 1901.